A COMPARATIVE SALES METHOD FOR MASS APPRAISAL

RESIDENTIAL VALUATION MODELS
CITY OF OSHAWA
1969

Assessment Standards Branch
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PREFACE AND ACKNOWLEDGEMENTS

This report outlines the results of research in the application of statistical methods and computer technology to real property valuation for tax assessment. This research was carried out by the Assessment Standards Branch, Ontario Department of Municipal Affairs, and a very early version of some of the work involved was reported in Methodology Section, Multivariate Analysis and Residential Property Valuation in Ontario (Toronto, October 1970).

The present report deals only with the valuation of single family residential property. This is not meant to imply that the valuation techniques considered are restricted to residential valuations, but only that single family residential property was selected as a convenient point of departure, and work has not yet progressed beyond this stage.

The early report indicated above was couched in what we now regard as a misleadingly "technistic" manner. Consequently, an attempt has been made to couch the present report in as concrete and straightforward a way as possible. This reflects both a hope that the resulting material will be more accessible to the general valuation reader, and a growing conviction that the essential elements of the work are not of a highly technical nature.

The research presented in the report was conducted under the general supervision of Angus N. MacKay, Director, Assessment Standards Branch, Ontario Department of Municipal Affairs. Without his enthusiasm and support whatever progress has been made would not have been even remotely possible.

Several other people also made substantive contributions to the research. Gerry Meredith, formerly Assessment Commissioner, Ontario County Assessment Region, and now Assessment Commissioner Niagara Assessment Region, Ontario Department of Municipal Affairs, provided the Oshawa data which forms the empirical basis of the report, and both he and his staff offered a great deal of help in more intangible (and more important) ways. Steve Solway, Management Science Branch, Ontario Treasury Board secretariat, provided critical guidance on statistical methods and on the statistical elements of computer programs. Bill Yuille, programming consultant to the Systems Development Branch, Ontario Department of Municipal Affairs, took great pains to develop a system of computer programs closely suited to the needs of valuation research. Finally, Jim Tait, Valuation Section, Assessment

Standards Branch, Ontario Department of Municipal Affairs, calmly attended to much of the detailed work associated with the analysis of data, and kept the inevitable tangle of research administration in consistently good order.

As in any work of this sort, many other people made important contributions in less direct ways. In its early stages the research profited from the advice of S. D. Khosla, presently with Statistics Canada in Ottawa, and Leigh Bailey and Gordon Van Toen, Computer Services Centre, Government of Ontario. The research also benefited a great deal from earlier work in the same field by Robert Gustafson, State Board of Equalization, Government of California, and William Shenkel, Department of Real Estate, University of Georgia, and Mr. Gustafson kindly provided a variety of documentation on his work with statistical valuation. Last (but by no means least), staff in the Assessment Standards Branch (especially in the former Methodology Section), and field assessors in several Regional Offices, Ontario Department of Municipal Affairs, provided no end of stimulating criticism and useful advice.

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PRINCIPLES OF THE COMPARATIVE SALES METHOD FOR MASS APPRAISAL

In the last five years a substantial amount of research has been undertaken into the use of computer technology, statistical methods, and market data to produce real estate valuations for property tax assessment.[1] For the most part this work has tended to treat statistical analysis of market data as a mathematical exercise for computer, rather than as a valuation exercise rooted in principles recognized by conventional appraisal theory. Consequently, although the statistical and computer components of the valuation methods presented in this report are important in themselves, we feel that their ultimate success depends on the skill with which they are integrated into traditional comparative sales methods of valuation.

To clarify the relationship between traditional and mass appraisal methods, the report begins by outlining each method in turn. The purpose of these outlines is to identify the major differences and similarities between the two methods, and to set out the basic principles behind our adaptation of the comparative sales method for mass appraisal (or "mass market approach"). The report then illustrates these principles with reference to a study of single family dwellings in the City of Oshawa.

THE TRADITIONAL COMPARATIVE SALES METHOD

Traditionally the comparative sales or market approach to real property valuation involves "the application of adjustment factors to comparable sales in order to establish a value for the subject property".[2] This procedure rests on a specific conception of property value, and a basic assumption about how value is "set" by real property markets.

Conception of Property Value. For the traditional market approach property value is a result of decisions made by buyers and sellers of real estate. These decisions are reflected in the prices at which properties exchange on real estate markets.[3]

Assumption of Identical Prices. The traditional market approach assumes that at a given time and place identical properties will tend to sell for identical prices. In the nature of things, "imperfections" in real property markets create some variation in the prices of virtually identical properties.[4] Consequently, certain authorities prefer to talk about similar properties that sell within a range of similar prices.[5] Regardless of how the assumption is cast, its implications for the mechanics of the traditional market approach are the same. The way to estimate market value for an unsold property is to analyse the prices of similar properties that have sold in the recent past.

Comparable Properties. The first major step in the traditional market approach involves collecting several recent sales of properties that are similar or "comparable" to the unsold, "subject" property being valued. The mechanics of this step imply that properties are comparable if they are similar with respect to characteristics which have an important influence on value.[6] Recognized authorities disagree about the relative importance of different property characteristics in specific cases. All authorities, however, pay at least lip service to the view that accurate judgements require "diligent market research".[7]

Price Adjustments. The second major step in the traditional market approach involves adjusting the prices of comparable sales to allow for important differences between subject and comparable properties, or to reflect what comparable properties would have sold for if they were virtually identical to the subject property being valued. Once this has been done, the market value of the subject property in question is estimated by devising some form of average adjusted price for comparable sales.[8] Although different authorities recommend different procedures for making price adjustments, all procedures depend a great deal on intuitive knowledge of local market data.[9] Along with obvious constraints associated with time, this lack of systematic procedure in the traditional market approach makes it highly unsuited to the requirements of mass appraisal.

AN ADAPTATION FOR MASS APPRAISAL

As presented in this report, the market approach in mass appraisal estimates the market value or most likely sale price of unsold properties, by establishing relationships between sale price and property characteristics for roughly similar properties that have sold in the recent past. Like the traditional market approach, this "mass market approach" rests on a specific conception of property value, and a basic assumption about how value is "set" by real property markets.

Conception of Property Value. For the mass market approach, as for the traditional market approach, property value is a result of decisions by buyers and sellers of real estate. From the standpoint of basic principles, the mass market approach is identical to the market approach described in conventional appraisal literature.

Assumption of Regular Relationships. The mass market approach assumes that at a given time and place relationships between sale price and important property characteristics are highly regular within broad groups of roughly similar properties. For example, at a given time and place a study of market data for a certain group of single family properties might indicate that a 100 square foot increase in floor area is regularly associated with a $1000 increase in sale price, while a ten year increase in the age of the house is regularly associated with a $2000 decrease in sale price.

The assumption of regular relationships in the mass market approach might be treated as an attempt to extend the assumption of identical prices in the traditional market approach. As with the traditional market approach, imperfections in real property markets create some degree of irregularity in relationships between property characteristics and sale price. It might be more realistic, for example, to say that within broad property groups relationships between sale price and property characteristics are at least regular enough to permit acceptable estimates of market value for roughly similar properties that have not sold. Regardless of how the assumption is cast, its implications for the mechanics of the mass market approach are the same. The way to estimate market value for a group of unsold properties is to establish relationships between sale price and property characteristics for roughly similar properties that have sold in the recent past.

Property Groups. The first major step in the mass market approach involves dividing all sales from some recent time period into several groups of roughly similar properties.[10] In principle this step parallels the selection of comparable sales in the traditional market approach, although in practice the procedures involved are somewhat different. In the mass market approach the purpose of the step is to isolate groups of properties within which relationships between sale price and property characteristics are as regular as possible.

The construction of property groups is constrained by one major consideration. As a general rule of thumb, each group must include approximately 100 sales. This requirement is designed to ensure that relationships between sale price and property characteristics established for each group can be reliably applied to properties that have not sold.[11] As a result of this rule of thumb, the number of groups which can be constructed for a given time and place depends on the number of sales available. Similarly, to the extent that only small numbers of sales are available, relationships between sale price and property characteristics within each group are likely to be less regular than where the number of sales is large.

Valuation Models. The second major step in the mass market approach involves establishing relationships between sale price and property characteristics for each group of roughly similar properties. Taken together, the relationships for a given group form a "valuation model".

Valuation models can be treated as loosely analogous to the price adjustments associated with the traditional market approach, although as in the case of property groups the actual procedures involved are somewhat different. In the mass market approach, for example, valuation models are constructed using a statistical technique known as "stepwise multiple regression analysis".[12] Roughly speaking this technique serves two major purposes. First, for a given property group it selects only those property characteristics that are significant for estimating market value. Second, for each significant characteristic regression analysis indicates a "weight", which assigns a dollar value to the relationship between sale price and the property characteristic in question.

PRACTICE OF THE COMPARATIVE SALES METHOD FOR MASS APPRAISAL

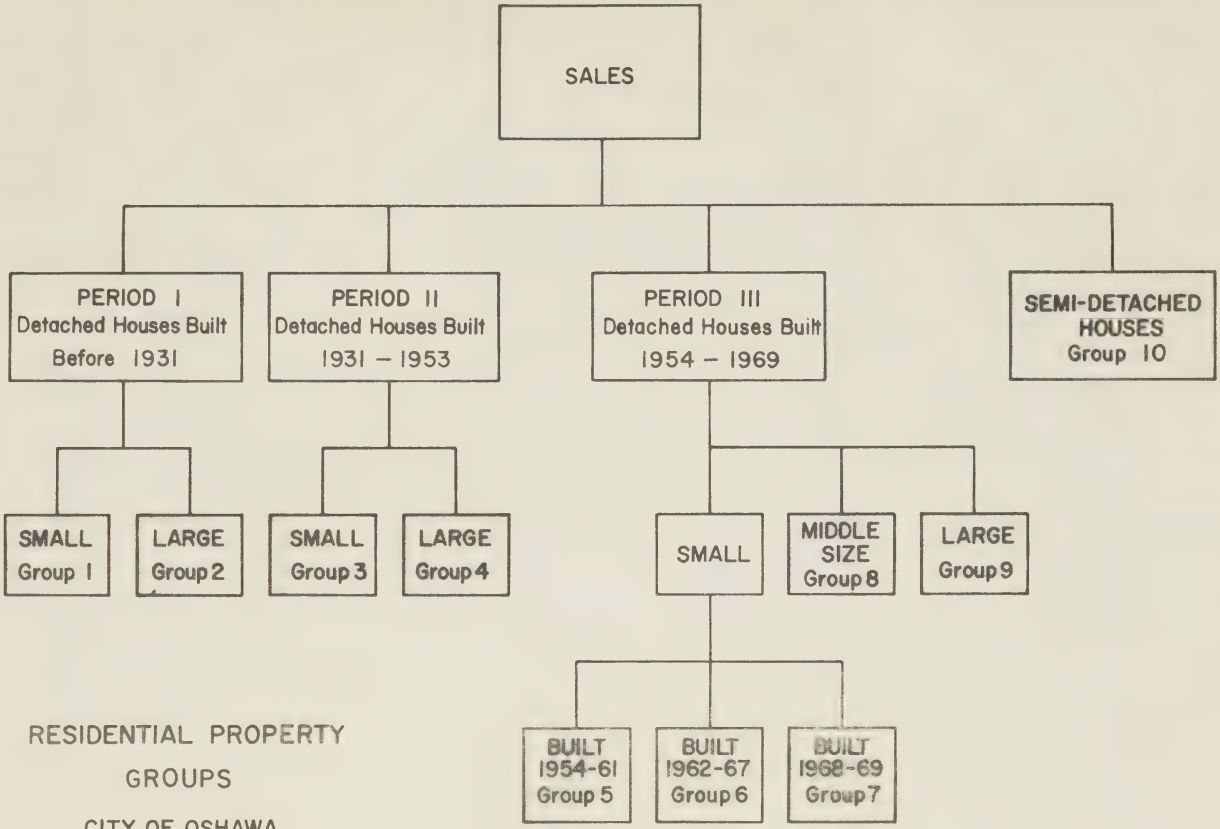
The principles of the mass market approach can be clarified by illustrating how they are used in actual practice. To this end, the report outlines the development of residential valuation models for the City of Oshawa (1970 population: 87,378) using sales data from the calendar year 1969. It is worth emphasizing that although the mass market approach can be applied at any time and place, the particular results presented here apply only to Oshawa in 1969.[13]

As general background, in the City of Oshawa, there were 1553 "valid" sales of single family residential property during 1969, of which 1506 sales were ultimately used to develop valuation models.[14] For each sale, information was collected on sale price and 37 property characteristics, which were hypothesized as having an important influence on value.[15] Information on 6 property characteristics was also collected for all properties in Oshawa, to explore the extent to which sold properties represent properties that have not sold.[16]

PROPERTY GROUPS

All 1506 single family sales in Oshawa were ultimately divided into 10 groups of roughly comparable properties, as indicated in Figure 1. These property groups were constructed using simple classifications of data, special statistical techniques,[17] first hand field inspection, and trial and error attempts to construct valuation models.

Grouping Characteristics. As outlined in Figure 1, initial analysis of all sales data almost immediately indicated that whether a house is completely detached or semi-detached has an important influence both on value and on all other property characteristics. Consequently, semi-detached was identified as a "grouping characteristic", and a separate property group was constructed for all 324 sales of semi-detached houses.[18] Analysis of the remaining 1182 sales of detached houses then led to the identification of two grouping characteristics for sales of detached single family properties in Oshawa in 1969. The first is building age, and the second building size (floor



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area).

These grouping characteristics meet two criteria. First, according to statistical tests, for all detached sales taken together building size and building age are closely associated with sale price. Second, on a similar basis, building size and building age are also closely associated with all other property characteristics. For example, large houses are more likely than small houses to have more bedrooms and bathrooms, to be located in "better" neighbourhoods, or to be placed on larger lots.

Construction of Groups. Figure 1 indicates that in addition to a distinct property group for semi-detached houses (Group 10), 9 groups were constructed for detached houses on the basis of variations in building size and building age (Groups 1-9). Roughly speaking, this was done by dividing all 1182 sales of detached houses into three broad classes of building age (Periods I, II, and III), and then subdividing these classes according to building size (Small, Large, and in one case, Middle Size).

Decisions about appropriate breaking points for these property groups - or answers to questions like "why divide at 1931 rather than 1925 or 1936?" - are ultimately systematic judgements, based on various statistical tests, trial and error attempts to develop valuation models, and a general knowledge of available market data. As noted earlier, this identification of breaking points is designed to isolate property groups within which relationships between sale price and property characteristics are as regular as possible.

VALUATION MODELS

Figure 2 sets out a separate valuation model for each of the 10 property groups identified in Figure 1. It is important to note that most property groups involve certain minor specifications, associated with characteristics other than semi-detached, building size, and building age. These specifications are designed to avoid problems of "representation", as indicated later.

Each model in Figure 2 is designed to estimate market value for unsold properties from the same group. To illustrate, the valuation model for Group 1 indicates that estimated mar-

OSHAWA RESIDENTIAL VALUATION MODELS - 1969

PERIOD I

SMALL (GROUP 1)

Group Specification

Detached House with Bathroom(s), Floor Area 400-1049, Built Before 1931, Exclude Split Level.

Valuation Model

Most Likely Sale Price
= $8800
+ $ 9.25 X Floor Area
- $ 60 X Building Age
+ $ 125 X Date of Sale
- $1300 if Wood Frame
+ $ 800 if in Neighbourhood 6

LARGE (GROUP 2)

Group Specification

Detached House with Bathroom(s), Floor Area 1050-2500, Built Before 1931, Exclude Split Level.

Valuation Model

Most Likely Sale Price
= $1700
+ $ 8.20 X Floor Area
- $ 60 X Building Age
+ $ 300 X Date of Sale
+ $ 65 X Site Frontage
+ $1100 if Garage
+ $3800 if in Neighbourhood 6

PERIOD II

SMALL (GROUP 3)

Group Specification

Detached House with Bathroom(s), Floor Area 400-949, Built 1931-1953, Exclude Split Level.

Valuation Model

Most Likely Sale Price
= $8400
+ $ 10.45 X Floor Area
- $ 200 X Building Age
+ $ 230 X Date of Sale
+ $ 50 X Site Frontage
- $1900 if Wood Frame

LARGE (GROUP 4)

Group Specification

Detached House with Bathroom(s), Floor area 950-2000, Built 1931-1953, and 1½ Storey Built 1954-1961, Exclude Split Level.

Valuation Model

Most Likely Sale Price
= $1100
+ $ 12.35 X Floor Area
- $ 190 X Building Age
+ $ 485 X Date of Sale
+ $ 75 X Site Frontage
- $1400 if Wood Frame
- $1300 if in Neighbourhood 8

PERIOD III

SMALL

1954 - 1961 (GROUP 5)

Group Specification

Detached House with Bathroom(s), Floor Area 600-1199, Built 1954-1961, Bungalow Only.

Valuation Model

Most Likely Sale Price
= $4000
+ $ 13 X Floor Area
- $ 475 X Building Age
+ $ 350 X Date of Sale
+ $ 90 X Site Frontage
+ $1700 if Garage
+ $3100 if in Neighbourhood 4
- $1400 if in Neighbourhood 13

1962 - 1967 (GROUP 6)

Group Specification

Detached House with Bathroom(s), Floor Area 900-1199, Bungalow Built 1962-67, and Split Level Built 1954-67.

Valuation Model

Most Likely Sale Price
= $10000
+ $ 8 X Floor Area
+ $ 250 X Date of Sale
+ $ 2500 if Split Level
+ $ 1200 if Carport
+ $ 2500 if Garage
- $ 1100 if in Neighbourhood 5
- $ 2500 if in Neighbourhood 13
+ $ 2400 if in Neighbourhood 3 or 4

1968 - 1969 (GROUP 7)

Group Specification

Detached House with Bathroom(s), Floor Area 1000-1199, Built 1968-69, Split Level and Bungalow.

Valuation Model

Most Likely Sale Price
= $9200
+ $ 7.25 X Floor Area
+ $ 200 X Date of Sale
+ $ 30 X Site Frontage
+ $ 800 if Split Level
+ $ 600 if Carport
+ $2000 if Garage
+ $ 600 if in Neighbourhood 4
+ $1200 if in Neighbourhood 12

MIDDLE - SIZE (GROUP 8)

Group Specification

Detached House with Bathroom(s), Floor Area 1200-1499, Built 1954-1969.

Valuation Model

Most Likely Sale Price
= $14000
+ $ 325 X Date of Sale
+ $ 60 X Site Frontage
+ $ 1700 if 1½ or more Bathrooms
+ $ 2000 if Carport
+ $ 3500 if Single Garage
+ $ 7300 if Double Garage
+ $ 2400 if in Neighbourhood 3
+ $ 1900 if in Neighbourhood 10
+ $ 2000 if Built After 1961

LARGE (GROUP 9)

Group Specification

Detached House with Bathroom(s), Floor Area 1500-2400, Built 1954-1969.

Valuation Model

Most Likely Sale Price
= $6200
+ $ 6.75 X Floor Area
+ $ 250 X Date of Sale
+ $ 50 X Site Frontage
+ $3000 if 2 or more Storeys
+ $2600 if 1½ Bathrooms
+ $5500 if 2 or more Bathrooms
+ $1700 if Single Garage
+ $5000 if Double Garage
- $4200 if in Neighbourhood 4
+ $5000 if in Neighbourhood 3
- $5000 if Built Before 1962

SEMI - DETACHED

Group Specification

Semi Detached House with Bathroom(s), Floor Area 500-1600, Exclude Semi's Built 1930-1953.

Valuation Model

Most Likely Sale Price
= $7000
+ $ 7 X Floor Area
+ $ 300 X Date of Sale
+ $ 250 if in Neighbourhood 13
- $6500 if Built Before 1931

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ket value for an unsold, small detached house in Period I is $8800 + $9.25 X Floor Area - $60 X Building Age + $125 X Date of Sale (in months) - $1300 if Wood Frame + $800 if in Neighbourhood 6. Consequently, assuming that the "date of valuation" is December 1969, if the unsold property in question has a 1000 square foot floor area, is 50 years old, solid brick, and in Neighbourhood 5, estimated market value is $8800 + $9.25 X 1000 - $60 X 50 + $125 X 12 = $16,550.

Construction of Models. The valuation models set out in Figure 2 were constructed using a computer program which incorporates the "stepwise multiple regression" technique referred to earlier. As already indicated, this technique serves two major purposes. For example, for properties in Group 3 the computer program indicates that of all the property characteristics for which data was collected, only floor area, building age, date of sale, site frontage, and wood frame are significant for estimating market value. It also indicates that the market value of unsold properties in Group 3 can be estimated by applying the following set of weights for significant characteristics: $8400 + $10.45 X Floor Area - $200 X Building Age + $230 X Date of Sale (in months) + $50 X Site Frontage - $1900 if Wood Frame.

Figure 2 indicates that different property characteristics and different weights are associated with valuation models for different property groups. For example, Site frontage is an important characteristic for Groups 2,3,4,5,7,8, and 9, but not for Groups 1,6, and 10. Similarly, the weight for building age in the model associated with Group 5 is -$475, while the weight for building age in the model associated with Group 1 is only -$60. This seems compatible with the conventional appraisal view that different property characteristics have different influences on value for different kinds of property.[19]

Special Problems. The construction of valuation models raises two special kinds of problem. Thorough discussion of these problems is beyond the scope of this report, and we will simply indicate what they involve in a general way.

The first problem concerns the issue of representation. To produce reliable value estimates for unsold properties, the mass market approach must obviously ensure that valuation models are based on groups of sold properties that adequately represent the

range of unsold properties to be valued. In slightly different language, it is at least risky to apply valuation models to kinds of unsold property that are not adequately represented by recent sales.

Representation is a difficult problem which might be impossible to resolve in a convincing way. Nonetheless, in recognition of its importance, 21 of the original 1553 "valid" sales of single family property in Oshawa were excluded from the data used to develop valuation models, since they involved highly "unusual" kinds of property.[20] This means that the valuation models set out in Figure 2 cover about 98% of all single family property in Oshawa. The remaining 2% of single family property require procedures that offer greater scope for individual judgement.[21]

The second problem involves the theoretical assumptions associated with various statistical techniques. Since a detailed treatment of this question would involve technical questions far removed from assessment practice, we will simply note that the valuation models in Figure 2 attempt to make some allowance for this special kind of problem.[22]

ACCURACY TESTS OF VALUATION MODELS

Figure 3 sets out various "test data" for each of the valuation models outlined in Figure 2. These tests are designed to indicate how well the valuation models estimate market value when compared with actual sale prices. The reasoning behind the tests is that if market value is "most likely sale price", then value estimates are "accurate" to the extent that they correspond closely to the actual prices of recently sold properties, and "inaccurate" to the extent that they do not.

Tests and Time. The tests set out in Figure 3 are based on the 1506 sales that were used to develop the valuation models outlined in Figure 2. These tests attempt to measure the extent to which the 10 valuation models "reproduce" the behavior of single family property markets in Oshawa during 1969.

It is also possible, of course, to test valuation models based on one year's sales data using data from some subsequent time period. This procedure was not practicable in the case of the

ACCURACY TESTS OF VALUATION MODELS

PERIOD I

SMALL (GROUP 1)

Test 1

% Deviation*	Properties Number	Properties %
± 5	48	30
±10	85	53
±15	120	75
±20	140	87
±25	148	92
±35	153	95
±50	156	97
±75	162	100

Test 2

Coefficient of Dispersion: 12.24

Median Ratio: 100.1

LARGE (GROUP 2)

Test 1

% Deviation	Properties Number	Properties %
± 5	39	33
±10	64	54
±15	87	74
±20	103	88
±25	111	95
±35	115	98
±50	118	100

Test 2

Coefficient of Dispersion: 10.4

Median Ratio: 100.8

PERIOD II

SMALL (GROUP 3)

Test 1

% Deviation	Properties Number	Properties %
± 5	43	41
±10	72	68
±15	87	82
±20	94	89
±25	99	94
±35	102	97
±50	104	99
±75	106	100

Test 2

Coefficient of Dispersion: 9.71

Median Ratio: 98.7

LARGE (GROUP 4)

Test 1

% Deviation	Properties Number	Properties %
± 5	21	23
±10	54	59
±15	73	80
±20	80	88
±25	85	93
±35	89	97
±50	91	99
±75	92	100

Test 2

Coefficient of Dispersion: 11.50

Median Ratio: 97.3

PERIOD III

SMALL 1954 - 1961 (GROUP 5)

Test 1

% Deviation	Properties Number	Properties %
± 5	74	44
±10	133	80
±15	152	91
±20	160	96
±25	164	98
±35	165	98
±50	165	98
±75	166	99
±100	167	100

Test 2

Coefficient of Dispersion: 7.60

Median Ratio: 98.4

SMALL 1962 - 1967 (GROUP 6)

Test 1

% Deviation	Properties Number	Properties %
± 5	60	47
±10	110	85
±15	119	92
±20	127	98
±25	128	99
±35	128	99
±50	129	100

Test 2

Coefficient of Dispersion: 6.48

Median Ratio: 100.8

SMALL 1968 - 1969 (GROUP 7)

Test 1

% Deviation	Properties Number	Properties %
± 5	113	80
±10	137	97
±15	138	98
±20	139	99
±25	139	99
±35	141	100

Test 2

Coefficient of Dispersion: 4.28

Median Ratio: 99.6

MIDDLE - SIZE (GROUP 8)

Test 1

% Deviation	Properties Number	Properties %
± 5	80	52
±10	124	81
±15	138	90
±20	146	95
±25	152	99
±35	153	100

Test 2

Coefficient of Dispersion: 6.21

Median Ratio: 100.4

LARGE (GROUP 9)

Test 1

% Deviation	Properties Number	Properties %
± 5	54	47
±10	84	74
±15	105	92
±20	110	97
±25	113	99
±35	113	99
±50	113	99
±75	114	100

Test 2

Coefficient of Dispersion: 7.12

Median Ratio: 100.0

SEMI - DETACHED

Test 1

% Deviation	Properties Number	Properties %
± 5	242	75
±10	310	96
±15	323	99
±20	324	100

Test 2

Coefficient of Dispersion: 3.64

Median Ratio: 100.2

* Percentage Difference Between
Actual Sale Price and Estimate of Sale Price

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Oshawa study presented here, since at the time of data collection single family sales for the time periods after 1969 were not readily available.

Testing against data from some subsequent time period is sometimes thought to be more reliable than testing against the same year's data, since it avoids using the same sales both to develop valuation models and to test the accuracy of value estimates. Two points about this issue are worth special emphasis. First, testing against the same year's data does not imply some kind of "cooking", associated with the direct substitution of actual sale prices for estimates of market value. Second, testing against data from some subsequent time period likely raises at least as many problems as those it might be thought to resolve. For example, it is difficult to tell whether discrepancies between value estimates and actual sale prices reflect inaccuracies in valuation methods, or general changes in property values from one time period to another.

Test 1. Figure 3 presents two different kinds of "accuracy test", both based on 1969 sales data. The first is a simple classification of percentage deviations between estimated market values and actual sale prices. To illustrate, if the estimated market value for a particular property is $25,000 and the actual sale price is $20,000, the percentage deviation is:

$$\frac{\$25,000 - \$20,000}{\$20,000} \times 100\% = +25\%.$$

Tables of percentage deviation for each of the 10 valuation models from Figure 2 are set out in Figure 3 under the heading "Test 1". Naturally, a valuation model where 80% of estimated market values are within ± 10% of actual price is more accurate than a model where only 60% of estimated values are within ±10% of actual price.

Test 2. The second test presented in Figure 3 is the "coefficient of dispersion". Since procedures for calculating this measure are outlined in standard assessment literature, they are not dealt with in this report.[23] It is worth noting, however, that the coefficient of dispersion is both a somewhat unstable guide to assessment quality, and difficult to interpret in any simple, concrete way.[24] In this context, the coefficient of dispersion is presented in Figure 3 not because of its intrinsic merits, but because it appears to be the only index of quality which currently enjoys a degree of recognition within the assess-

ment community as a whole.[25]

Results. If the results of the tests set out in Figure 3 are combined, 77% of the value estimates produced by all 10 valuation models taken together are within ±10% of sale price, and the overall coefficient of dispersion is 7.18%.[27] If the tests for each model are considered separately, Figure 3 clearly indicates that some valuation models are more accurate than others. Broadly speaking, models for newer houses are more accurate than models for older houses, and in most cases models for small to middle size houses are more accurate than models for larger houses.

There seem to be two possible explanations for these variations in accuracy among valuation models. First, the property groups associated with less accurate models (especially older houses) might involve important characteristics that are not included in the 37 characteristics for which data was initially collected. Second, relationships between sale price and property characteristics might be less regular for groups associated with less accurate models than for other groups, as a result of "intrinsic" imperfections in real property markets. To the extent that the first explanation is true, less accurate models might be improved by collecting additional data. To the extent that the second explanation is true, however, some valuation models will always be less accurate than others, simply because some kinds of property are more difficult to value.

APPLICATIONS TO UNSOLD PROPERTIES

Variations in accuracy among valuation models also have implications for the extent to which the overall accuracy associated with tests of sold properties will apply to properties that have not sold. In Oshawa during 1969, for example, when compared with unsold properties from the same group, sold properties tended to under represent property groups associated with less accurate valuation models, and to over represent property groups associated with more accurate valuation models. This suggests that the overall accuracy of the 10 valuation models indicated earlier (77% within ±10%, and 7.18% dispersion) will tend to fall somewhat when all properties are taken into account.

As mentioned before, to explore the way in which this issue in-

fluences the overall accuracy of value estimates for unsold properties, a certain amount of data was collected for all single family property in the City of Oshawa. The following table uses this data to compare the percentage of "all properties" in each of the 10 property groups from Figure 1 with similar percentages for "sold properties". The table shows, for example, that 12% of all properties but only 8% of sold properties are in Group 2. Yet, Figure 3 indicates that the valuation model associated with Group 2 is the second "most inaccurate" of all 10 models. On the other hand, only 2% of all properties but 9% of sold properties are in Group 7. Yet, Figure 3 indicates that the model associated with Group 7 is the "most accurate" of all 10 models.

DISTRIBUTION OF PROPERTIES IN OSHAWA BY PROPERTY GROUPS, 1969

1969 Residential Property Groups	All Properties		Sold Properties	
	Number	Percent	Number	Percent
1	1725	11	162	11
2	1848	12	118	8
3	1621	10	106	7
4	1859	12	92	6
5	3559	23	167	11
6	1827	12	129	9
7	259	2	141	9
8	1288	8	153	10
9	781	5	114	8
10	861	5	324	21
Total	15628	100	1506	100

If all models taken together were applied to all properties, it seems that about 72% of value estimates would be within ±10% of actual sale price, while the coefficient of dispersion would be about 8½%.28 Although these calculations are quite crude, they strongly suggest that in terms of currently accepted "standards of excellence" the mass market approach outlined in this report can produce acceptable assessment valua-

tions. At the same time, no clear judgement about the utility of this approach in property tax assessment is possible until the techniques involved have been evaluated under practical field conditions. In this sense the work presented here can be viewed as a "technical" basis for more detailed studies of problems in implementation and administration.

NOTES AND REFERENCES

1. See, e.g., Robert Gustafson, "Developing a Central EDP System", Proceedings of the 35th Annual International Conference on Assessment Administration (Chicago, 1970), 34-58; and William M. Shenkel, "Computer Valuation By Multiple Regression Analysis", Proceedings of the 34th Annual International Conference on Assessment Administration (Chicago, 1968), 26-39.

2. Paul Wendt, Real Estate Appraisal (New York, 1956), 280.

3. It is widely recognized, of course, that prices associated with "invalid" sales do not accurately reflect property value, and should be excluded from valuation work. See, e.g., Appraisal Institute of Canada, Real Estate Appraising in Canada (Winnipeg, 1970), 245-246; American Institute of Real Estate Appraisers, The Appraisal of Real Estate (Chicago, 1967), 338-343; Sanders A. Cahn, Frederick E. Case, and Alfred Schimmel, Real Estate Appraisal and Investment (New York, 1963), 90-93; and Angus N. MacKay, Appraisal Notes for the Assessor (Toronto, 1968), 32-35.

4. Typical factors that contribute to imperfections in real property markets are "the basic nonhomogeneity of real estate", and inadequate market organization leading to poor communications among buyers and sellers. See, e.g., Wendt, Real Estate Appraisal, 254-255.

5. This point of view has been most closely associated with the work of Richard Ratcliff. See, e.g., Modern Real Estate Valuation (Madison, Wisc., 1965), Ch. III; and "Market Value Cannot Be Estimated", The Real Estate Appraiser, January-February 1970, 16-19.

6. See, e.g., Wendt, Real Estate Appraisal, 265-267.

7. Ibid., 266.

8. By convention, of course, adjustments are also made for "non-property characteristics" (like time of sale and financing arrangements) that have an important influence on market value. See references cited in note 3.

9. See, e.g., Appraisal Institute of Canada, Real Estate Appraising, 249-251; and American Institute, The Appraisal of Real Estate, 345-347. For an interesting attempt to resolve some of the problems associated with price adjustments in the traditional market approach see Richard Ratcliff and Dennis Swan, "Getting More From Comparables by Rating and Regression", The Appraisal Journal, January 1972, 68-75.

10. As in the traditional market approach, accepted procedures are followed with regard to matters like "invalid sales" and financing arrangements (see notes 3. and 8.) Similarly, see Figure 2 (p. 8) for examples of differences in value associated with time of sale.

11. This minimum group size of 100 sales is somewhat arbitrary, but if anything seems more than adequate both in terms of the theory behind multiple regression analysis, and in terms of other reported uses of the technique in real property valuation. See, e.g., Fred E. Case, "New Decision Tools for Appraisers", Appraisal Journal, January 1967, 21-27; and Robert A. Blettner, "Mass Appraisal Via Multiple Regression Analysis", Appraisal Journal, October 1969, 513-521.

12. See John Fruend, Modern Elementary Statistics (Englewood cliffs, N.J., 1967), Ch. 14, for a simple outline of the principles of regression analysis; and Norman Draper and H. Smith, Applied Regression Analysis (New York, 1966), for a more complete discussion of the actual procedures associated with regression techniques.

13. It is important to note that "place" does not necessarily mean "municipality". As indicated in the text (p. 5), each valuation index requires about 100 sales. Consequently, within the confines of common sense and dependable local knowledge, "place" is defined so as to generate a sufficient number of sales for effective analysis.

14. The following table classifies the various reasons for excluding certain sales from analysis:

NUMBER OF PROPERTIES EXCLUDED FROM OSHAWA ANALYSIS

Properties with Data Collection Errors.....26

Properties with Unusual Characteristics.....21

Period I: Floor Area Over 2500 sq. ft.	3
Period II: Floor Area Over 2000 sq. ft.	2
Period III: Floor Area Over 2400 sq. ft.	2
Two Storey Houses with Floor Area Under 1200 sq. ft.	3
Houses with Less Than One Bathroom	11
Total Number of Properties Excluded	47
Number of Properties Included in Analysis	1506

(Periods I-III relate to building age in Figure 1, p. 6.

15. The following table sets out the property characteristics for which data on sold properties was collected:

SINGLE FAMILY CHARACTERISTICS, SOLD PROPERTIES, OSHAWA, 1969

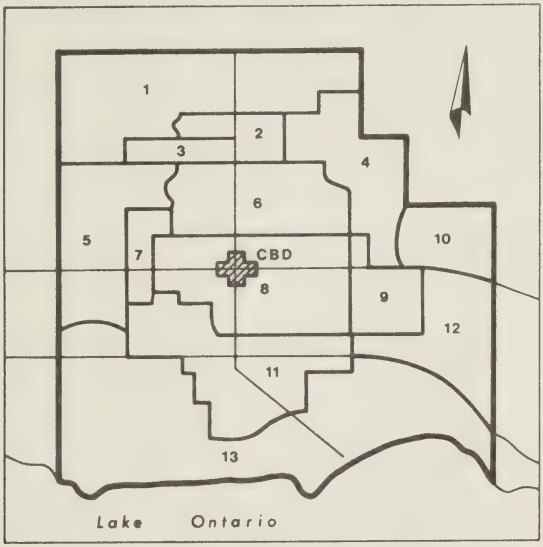
TRANSACTION CHARACTERISTICS		SITE CHARACTERISTICS	
1. Total Sale Price (Dollars)		3. Frontage (Feet)	
2. Date of Sale (Months)		4. Depth (Feet)	
BUILDING CHARACTERISTICS			
5. Floor Area		15. Structure:	Solid Brick
6. Building Age		16.	Concrete, Stone
7. Rooms		17.	Brick Veneer
8. Bedrooms		18.	Wood
9. Design:	Semi-Detached	19. Garage:	No Garage
10.	Split-Level	20.	Carport
11.	Bungalow	21.	Single Garage
12.	1½ Storey	22.	Double Garage
13.	2 Storey	23. Bathrooms:	One Bathroom
14.	More than 2 Storey	24.	1½ Bathrooms
		25.	2 or More Bathrooms

(Table Continued)

(Table Continued)

LOCATIONAL CHARACTERISTIC
Neighbourhoods 1 to 13, Variables 26 to 38

"Neighbourhoods" are defined as geographic areas within which locational advantage is felt to be relatively homogeneous. The neighbourhood boundaries shown on the following map of Oshawa were developed through consultation with local assessment staff and extensive field surveys.



OSHAWA NEIGHBOURHOODS

16. The following table sets out the property characteristics for which data on all properties were collected:

SINGLE FAMILY CHARACTERISTICS, ALL PROPERTIES, OSHAWA, 1969

1. Site Frontage	4. Building Age	
2. Site Depth	5. Building Design:	Detached
3. Total Floor Area	6.	Semi Detached

17. Description of these techniques is beyond the scope of this report. Persons who wish more information should consult Harry H. Harman, Modern Factor Analysis (Chicago, 1967); and John Sonquist and James Morgan, The Detection of Interaction Effects (Ann Arbor, Mich., 1964).

18. In mild defiance of an old convention we treat semi-detached houses as single-family rather than multi-family dwellings, and consequently they fall within the scope of our current work. This raises a minor but interesting point concerning the influence of valuation methods on assessment terminology. From the standpoint of construction cost it makes sense to treat semi-detached houses as multi-family dwellings, since the entity actually constructed is a dwelling unit for two families. From the standpoint of market analysis, however, it makes more sense to treat semi-detached houses as single-family dwellings, since the entity typically exchanged "on the market" is a dwelling unit for one family.

19. See, e.g., Appraisal Institute of Canada, Real Estate Appraising, 246-247.

20. See note 13.

21. It is worth emphasizing that even where the tradional "cost approach" to assessment valuation is used, special attention is required for unusual residential properties.

22. See, e.g., Jack Lessinger, "Econometrics and Appraisal", The Appraisal Journal, October 1969, 501-502.

23. See, e.g., Frederick Bird, The General Property Tax: Findings of the 1957 Census of Governments (Chicago, 1960), Ch. 6.

24. See, e.g., Dick Netzer, Economics of the Property Tax (Washington, 1966), 177-182.

25. Ibid.

26. See, e.g., Robert Craig, "Property Assessment at Market Value", Appraisal Institute Magazine, Winter 1970-71, 2-16; and John Rackham, "Land Valuation: A Priority Problem in Assessment Administration", Assessors Journal, October 1969, 3-15.

27. The figure of 77% is derived by summing the number of estimates within $\pm$10% from all ten valuation models, and then

dividing by 1506 which is the total number of sales used to develop the models. The figure of 7.18% is simply the average coefficient of dispersion for all ten models, weighted by the number of sales in each case.

28. The following sets out the method used to derive these two figures:

ACCURACY OF VALUATIONS FOR ALL PROPERTIES IN OSHAWA, 1969

1969 Residential Property Groupings	Sold Properties	All Properties	
	% Between ±10% Deviation* (1)	Number (2)	No. Between ±10% Deviation (1) X (2)
1.	53	1725	914
2.	54	1848	998
3.	68	1621	1102
4.	59	1859	1097
5.	80	3559	2847
6.	85	1827	1553
7.	97	259	251
8.	81	1288	1043
9.	74	781	578
10.	96	861	827
Total		15628	11210

% of Value Estimates Between ±10% of Actual Sale Price = $\frac{11210}{15628}$ X 100 = 72%

Coefficient of Dispersion = Average of the Coefficents of Dispersion for All Ten Models, Weighted by the Number of Properties in Each Group = 8.57%

* These figures are taken from Figure 3, p.11.